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MEDIUM FOR IDENTIFYING MATTER TO BE IDENTIFIED AND METHOD FOR PRODUCTION THEREOF

Abstract:

12bb Abstract of EP1327895

In an identification medium for identifying an authenticity of an object either visually or optically by using an identification device, high polymer cholesteric liquid crystal is applied onto the object, onto a sticker adapted to affixed to the object or onto a base for hot stamping onto the object, and the high polymer cholesteric liquid crystal is patterned, and/or a graphic representation layer such as a figure and letter is formed under or over the high polymer cholesteric liquid crystal to enhance the aesthetic quality of the identification medium or the object, and improve the capability to identify and prevent forgery.

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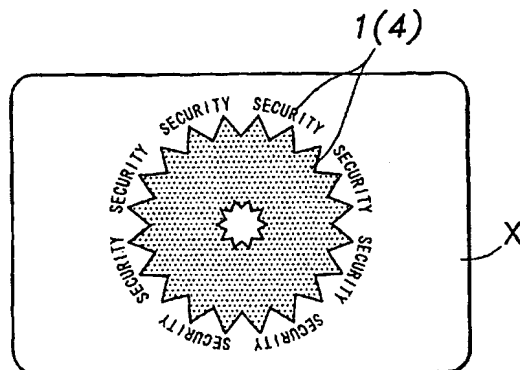
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(54) **MEDIUM FOR IDENTIFYING MATTER TO BE IDENTIFIED AND METHOD FOR PRODUCTION THEREOF**

(57) In an identification medium for identifying an authenticity of an object either visually or optically by using an identification device, high polymer cholesteric liquid crystal is applied onto the object, onto a sticker adapted to affixed to the object or onto a base for hot stamping onto the object, and the high polymer chole-

steric liquid crystal is patterned, and/or a graphic representation layer such as a figure and letter is formed under or over the high polymer cholesteric liquid crystal to enhance the aesthetic quality of the identification medium or the object, and improve the capability to identify and prevent forgery.

Fig. 1



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Description

TECHNICAL FIELD

[0001] The present invention relates to a medium and method for preventing forgery of two-dimensional and three-dimensional objects such as passports, cards, security notes, gift certificates, pictures, public transportation tickets, and public betting tickets.

BACKGROUND OF THE INVENTION

[0002] Conventionally, hologram has been used as an identification medium for preventing the forgery of cards, security notes and coupons. However, as the fabrication of hologram gets easier over time, forgery has become more and more common, and some of the cases of forgery, in particular those in connection with media for visual identification, are so undistinguishable from authentic ones that it is virtually impossible to tell them apart. Therefore, there is a need for new identification media.

[0003] Japanese patent laid open publication (kokai) No. 63-51193 discloses the use of high polymer cholesteric liquid crystal as an identification medium, and the light reflected therefrom is detected either visually or by using an optical identification device.

[0004] Cholesteric liquid crystal normally has a layered structure, and the axial directions of the molecules in each layer are parallel to each other as well to the plane of the layer. Each layer is slightly twisted relative to the adjacent layer so that a three-dimensional spiral structure is produced. This structure demonstrates the property to selectively reflect a circularly polarized light having a wavelength of λ which is given by $\lambda = n \cdot p$ where p is the depth of the layers for this axial direction to turn 360 degrees or the pitch, and n is the average index of refraction of each layer. Low polymer cholesteric liquid crystal is used for thermometers whose color changes with temperature because the pitch p distinctly changes with temperature as well as for display devices.

[0005] On the other hand, high polymer cholesteric liquid crystal is provided with a relatively fixed crystal structure so that the pitch p changes very little with temperature, magnetic field and electric field, and selectively reflects light of a certain predetermined color (wavelength). High polymer cholesteric liquid crystal can be prepared, for instance, by heating high polymer having a property to be formed into thermotropic cholesteric liquid crystal beyond the liquid crystal transition temperature to cause a liquid crystal structure to grow, and fixing the liquid crystal structure by rapidly cooling it.

[0006] For instance, when high polymer cholesteric liquid crystal that reflects red light having a prescribed wavelength λ_R is placed over material which absorbs visible light such as black paper, and random light such as sun light is projected thereon, the transmissive light is totally absorbed by the underlying black paper, and

only left circularly polarized light having the wavelength of λ_R is reflected. It produces an attractive special color which may be called as cholesteric color. This light however can be shut off if a filter for blocking left circularly polarized light is placed thereon.

[0007] When high polymer cholesteric liquid crystal that reflects red light having a prescribed wavelength λ_R is placed over material which reflects visible light such as white paper, and random light such as sun light is projected thereon, the underlying white color becomes visible. If a filter for transmitting only left circularly polarized light is placed thereon, only the reflected left circularly polarized light having the wavelength of λ_R become visible as red light. If left circularly polarized light having the wavelength of λ_R instead of sun light is projected thereon, only the reflected light having the wavelength of λ_R becomes visible even without using a filter.

[0008] However, when reflected light is used for identification purpose, although the high polymer cholesteric liquid crystal demonstrates a unique cholesteric color, and is attractive in appearance, it cannot provide a generally agreeable appearance by itself, and has been considered inadequate as an identification medium of an object whose aesthetic appearance is important. The graphic shapes (graphic shapes and patterns) formed on the identification medium are also an important factor in identifying the object. In this regard also, a further improvement of identification media using high polymer cholesteric liquid crystal is desired.

BRIEF SUMMARY OF THE INVENTION

[0009] The present invention was made in view of such problems of the prior art, and its primary object is to provide an identification medium which provides an improved identification capability, is highly difficult to illicitly duplicate, is highly attractive in terms of both shape and color, and is easy to fabricate, and a method for making such an identification medium.

[0010] According to the present invention, such an object can be accomplished by providing an identification medium for identifying an authenticity of an object either visually or optically by using an identification device, characterized by that: the identification medium comprises high polymer cholesteric liquid crystal which is patterned, and/or a graphic representation layer such as a figure and letter which underlies or overlies high polymer cholesteric liquid crystal, and by providing a method for making an identification medium for identifying an authenticity of an object either visually or optically by using an identification device, characterized by the steps of: applying high polymer cholesteric liquid crystal onto the object, onto a sticker adapted to be affixed to the object or onto a base for hot stamping onto the object, and patterning the high polymer cholesteric liquid crystal, and/or forming a graphic representation layer such as a figure and letter under or over the high polymer cholesteric liquid crystal.

[0011] This enhances the aesthetic appearance, and improves the capability to identify the object and prevent an illicit duplication of the object.

[0012] In particular, by patterning the high polymer cholesteric liquid crystal by etching or by using laser, the high polymer cholesteric liquid crystal can be accurately and easily patterned into a desired shape so that its aesthetic appearance and identification capability can be both improved. By printing on the high polymer cholesteric liquid crystal, the printed color shows on the printed part and the cholesteric color shows on the exposed surface of the high polymer cholesteric liquid crystal so that the freedom in design is enhanced. By thermally transferring the high polymer cholesteric liquid crystal according to a prescribed pattern, small batch production is facilitated. By partly modifying the high polymer cholesteric liquid crystal by laser, the high polymer cholesteric liquid crystal is provided with partly different optical properties, and its aesthetic appearance and identification capability can be both improved.

BRIEF DESCRIPTION OF THE DRAWINGS

[0013] Now the present invention is described in the following with reference to the appended drawings, in which:

Figure 1 is a plan view showing an identification medium given as a first embodiment of the present invention;

Figure 2 is a diagram showing the manufacturing process of the identification medium of the first embodiment of the present invention;

Figure 3 is a plan view showing an identification medium given as a second embodiment of the present invention;

Figure 4 is a diagram showing the manufacturing process of the identification medium of the second embodiment of the present invention;

Figure 5 is a plan view showing an identification medium given as a third embodiment of the present invention;

Figure 6 is a plan view showing an identification medium given as a fourth embodiment of the present invention;

Figure 7a is a diagram showing a device for manufacturing the identification medium of the fourth embodiment of the present invention;

Figure 7b is a ribbon used in the manufacturing device;

Figure 8 is a diagram showing the manufacturing process of an identification medium of a fifth embodiment of the present invention;

Figure 9 is a diagram illustrating the manner by which the identification medium of the first embodiment is identified visually by using a right and left circularly polarizing filter;

Figure 10 is a diagram illustrating the manner by

which the identification medium of the first embodiment is identified visually by using a right and left circularly polarizing filter;

Figure 11 is a diagram illustrating the manner by which the identification medium of the second embodiment is identified visually by using a right and left circularly polarizing filter;

Figure 12 is a diagram illustrating the manner by which the identification medium of the third embodiment is identified visually by using a right and left circularly polarizing filter;

Figure 13 is a diagram illustrating the manner by which the identification medium of the fourth embodiment is identified visually by using a right and left circularly polarizing filter;

Figure 14 is a diagram illustrating the manner by which the identification medium of the fourth embodiment is identified visually by using a right and left circularly polarizing filter;

Figure 15 is a diagram showing the structure of a device for mechanically identifying an identification medium according to the present invention;

Figure 16 is a graph showing the output of a light receiving unit of the identification device of Figure 15;

Figure 17a is a front view showing an actual exemplary layout and structure of the identification device of Figure 15;

Figure 17b is a sectional side view taken along line XVII-XVII of Figure 17a;

Figure 18a is a front view showing another actual exemplary layout and structure of the identification device of Figure 15; and

Figure 18b is a sectional side view taken along line XVIII-XVIII of Figure 18a.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0014] Preferred embodiments of the present invention are described in the following.

[0015] Figure 1 is a plan view showing a first embodiment of the present invention including an identification medium 1 which is affixed generally to an object X or to a prescribed location thereof and consists of a single part or two or more parts, the object consisting of a card, passport, security note, gift certificate or the like. Referring to Figure 2, the identification medium 1 is formed as a sticker by (a) coating high polymer cholesteric liquid crystal 4 over a base film 3, (b) applying a layer of resist 5 over the assembly, (c) photographically exposing the resist 5 by using a mask having a prescribed pattern as shown in Figure 1 and curing the resist, (d) etching away the part of the resist which has not cured and the high polymer cholesteric liquid crystal under it by using acid or alkaline chemicals such as nitric acid, hydrochloric acid and ammonium fluoride, (e) removing the remaining resist, and (f) generally applying a coating of a bond-

ing agent or adhesive agent 6. The etching may also consist of dry etching using carbon tetrafluoride, for instance, instead of the wet etching using the above mentioned chemicals.

[0016] The identification medium 1 in the form of a sticker is used with the base film 3 facing outward, and is affixed to the object X via the bonding agent or adhesive agent 6.

[0017] The bonding agent or adhesive agent 6 has such a high mechanical strength that any attempt to peel off the sticker from the object X will result in the destruction of the high polymer cholesteric liquid crystal 4, thereby preventing the reuse of the sticker.

[0018] In practice, the identification medium may also be formed directly on the surface of the object X by the steps of (a) to (e). If high polymer cholesteric liquid crystal 4 is applied to a base film 3 via a peel layer, and a hot melt layer is applied thereon following an etching process, the assembly can be used as a medium for hot stamping which is suitable for mass production. Hot stamping consists of a process by which an ornamental film is transferred onto the surface of an object by using instantaneous heat and pressure.

[0019] By etching the high polymer cholesteric liquid crystal 4, highly fine patterns and letters can be formed at will. This contributes to the enhancement of aesthetic quality and the protection of forgery.

[0020] Figure 3 is a plan view showing a second embodiment of the present invention including identification medium 11 which is affixed generally to the surface of an object X or to a prescribed location thereof and consists of one or a plurality of parts. As shown in Figure 4, the identification medium 11 is prepared in the form of a sticker by (a) coating high polymer cholesteric liquid crystal 14 over a base film 13, (b) printing a layer of ink 15 thereon according to a prescribed pattern as illustrated in Figure 3, and (c) generally applying a coating of a bonding agent or adhesive agent 16. In this embodiment also, the identification medium may be directly formed on the surface of the object X or may be formed as a medium for hot stamping.

[0021] In this embodiment also, the high polymer cholesteric liquid crystal 14 and ink layer 15 may be directly formed on the object X, instead of on the base film 13, as was the case with the first embodiment, and the assembly may also be used as a medium for hot stamping.

[0022] Figure 5 is a plan view showing a third embodiment of the present invention including an identification medium 21 which is affixed generally to the surface of an object X or to a prescribed location thereof, and consists of one or a plurality of parts. In this identification medium assembly, a layer of high polymer cholesteric liquid crystal 24 is formed into a desired shape as was done in the first embodiment, and a desired printing process is performed as was done in the second embodiment. Numeral 21a denotes a part which has been etched away, and numeral 21b denotes a part which is

printed.

[0023] Figure 6 is a plan view showing a third embodiment of the present invention including an identification medium 31 which is affixed generally to the surface of an object X or to a prescribed location thereof. This identification medium 31 is a combination of three parts of high polymer cholesteric liquid crystal 34a, 34b and 34c having three different kinds of reflective wavelength selectivity and/or circularly polarizing reflective property of a specific direction (right or left). For instance, the medium may include three parts of high polymer cholesteric liquid crystal that reflect right circularly polarized light of three different colors, blue color for the letters 34a, red color for the central star-shaped region 34b and green color for the outer star-shaped region 34c. Therefore, if the surface of the object X is black in color, for instance, the patterns and letters in the three colors can be visually seen. The colors also change depending on the color of the surface of the object X and the color of the bonding agent. When a circularly polarizing filter is used as will be described hereinafter, an even more accurate determination of authenticity becomes possible.

[0024] The identification medium 31 is formed by transferring the three parts of high polymer cholesteric liquid crystal 34a, 34b and 34c having different properties supported by a ribbon onto the object X at a prescribed pattern as shown in Figure 7a. More specifically, as shown in Figure 7b, the ribbon 37 is formed by placing three parts of high polymer cholesteric liquid crystal on a base film 33 one next to the other, coating a bonding agent 36, and winding the assembly into a roll. Heat is applied to the ribbon by using a thermal head 38 of a thermal printer at a prescribed timing while the ribbon 37 is moved relative to the object X in the same way as in a known thermal printer. Thereby, desired parts of the high polymer cholesteric liquid crystal are peeled off from the base film 33, and are transferred upon the object X at the prescribed pattern.

[0025] The process of transferring the corresponding parts of the high polymer cholesteric liquid crystal does not require a metallic die set or a master plate, and allows letters and shapes to be formed at will. In particular, a substantial saving in cost can be achieved when the production batches are small in quantity. By increasing the number of kinds of the high polymer cholesteric liquid crystal that are used, the number of available colors increases.

[0026] Furthermore, as shown in Figure 8, letters and patterns 45 can also be drawn by scorching and discoloring selected parts of the high polymer cholesteric liquid crystal 44 by using a laser device 40. If the power of the laser is controlled, and the scorching process is conducted in a gradual manner, it is possible to change the pitch p (the distance required for each layer to twist by one turn) and change the color of the reflected light. Therefore, letters and patterns can be formed by the parts which are subjected to the laser and have thereby been made to reflect light of different colors.

[0027] In the first embodiment, if the high polymer cholesteric liquid crystal 4 of the identification medium 1 reflects only red right circularly polarized light and the bonding agent 6 is transparent while the surface of the object X is black or the bonding agent is black, the view obtained by a simple identification device 51 consisting of a left circularly polarizing filter 51a and a right circularly polarizing filter 51b placed one next to the other will be as given in Figure 9. More specifically, the right circularly polarizing filter 51b allows the image formed by the high polymer cholesteric liquid crystal 4 of the identification medium 1 that reflects only right circularly polarized light or the graphic pattern of the identification medium 1 to be transmitted or viewed. On the other hand, the left circularly polarizing filter 51a shuts off the graphic pattern of the identification medium 1 from view, and allows only the surface of the object X or the black background of the bonding agent 6 to be viewed. If the bonding agent 6 is transparent and a pattern is formed on the surface of the object X, the identification medium 1 appears semi-transparent, and the surface pattern and graphic pattern of the identification medium show dimly to the naked eye. However, the simple identification device 51 allows only the surface pattern to be viewed as shown in Figure 10 because the left circularly polarizing filter 51a shuts off the graphic pattern of the identification medium 1.

[0028] In the second embodiment, if the high polymer cholesteric liquid crystal 14 of the identification medium 11 reflects only red right circularly polarized light, the view obtained by the simple identification device 51 will be as given in Figure 11. More specifically, the right circularizing filter 51b transmits only the light reflected by the high polymer cholesteric liquid crystal 14 thereby making the ink 15 or printed image underlying the high polymer cholesteric liquid crystal 14 invisible while the left circularly polarizing filter 51a shuts off the light reflected by the high polymer cholesteric liquid crystal 14 thereby making only the printed image or the ink 15 underlying the high polymer cholesteric liquid crystal 14 visible.

[0029] In the third embodiment, if the high polymer cholesteric liquid crystal 24 of the identification medium 21 reflects only red right circularly polarized light, the view obtained by the simple identification device 51 will be as given in Figure 12. More specifically, the right circularizing filter 51b makes only the image etched out of the high polymer cholesteric liquid crystal 24 visible while the left circularly polarizing filter 51a shuts off the light reflected by the high polymer cholesteric liquid crystal 24 thereby making only the printed letters 21b visible.

[0030] In the fourth embodiment, if the three parts of the high polymer cholesteric liquid crystal 34a, 34b and 34c of the identification medium 31 reflect only right circularly polarized light of different colors, and the bonding agent (not shown in the drawing) is transparent while the surface of the object X is black or the bonding agent

is black, the view obtained by a simple identification device 51 will be as shown in Figure 13 when the bonding agent is black and as shown in Figure 14 when the bonding agent is transparent. The pattern appears in the same way as the first embodiment illustrated in Figures 9 and 10, and only the colors are different.

[0031] The device for mechanically identifying the identification medium such as those given in the first to fifth embodiments is described in the following. Referring to Figure 15, the identification device 61 consists of a pair identification units 61a and 61b. The identification unit 61a comprises a light source 62, a light receiving unit 63 and a right circularly polarizing filter 64 so that right circularly polarized light is impinged upon the object X and only right circularly polarized light is transmitted to the light receiving unit 63 while left circularly polarized light is shut off. The identification unit 61b comprises a light source 65, a light receiving unit 66 and a left circularly polarizing filter 67 so that left circularly polarized light is impinged upon the object X and only left circularly polarized light is transmitted to the light receiving unit 66 while right circularly polarized light is shut off. The light sources 62 and 65 preferably consist of light bulbs, LEDs or laser sources, but are not limited to them.

[0032] The light receiving outputs from the light receiving units 63 and 66 of these identification units are given in Figures 16 for the cases of an identification medium consisting of high polymer cholesteric liquid crystal, a metallic vapor deposition layer tinted so as to have the appearance of high polymer cholesteric liquid crystal, and a combination of such a metallic vapor deposition layer and a film producing a phase delay of one-half the wavelength.

[0033] In the case of high polymer cholesteric liquid crystal, the light receiving unit 63 of the identification unit 61a produces an output because the right circularly polarized light reflected by the high polymer cholesteric liquid crystal transmits through the right circularly polarizing filter 64 while the light receiving unit 66 of the identification unit 61b does not produce an output because left circularly polarized light is impinged upon the high polymer cholesteric liquid crystal, and no light is reflected therefrom.

[0034] In the case of a metallic vapor deposition layer, there is no substantial output from the light receiving unit 63 because right circularly polarized light is reversed by the metallic vapor deposition layer in the identification unit 61a and converted into left circularly polarized light which is in turn shut off by the right circularly polarizing filter 64. There is also no substantial output from the light receiving unit 66.

[0035] When a phase delay film is placed over the metallic vapor deposition layer, an output is obtained from the light receiving unit 63 because right circularly polarized light is not reversed by the metallic vapor deposition layer in the identification unit 61a and reflected as right circularly polarized light which in turn transmits through the right circularly polarizing filter 64. Similarly, an output

is obtained from the light receiving unit 66.

[0036] Thus, when high polymer cholesteric liquid crystal is used, when a metallic vapor deposition layer is used, and when a combination of a metallic vapor deposition layer and a half-wavelength phase delay film is used, different kinds of output are obtained. The presence of high polymer cholesteric liquid crystal can be determined depending on if the received light output ratio (output from the light receiving unit 66 / output from the light receiving unit 63) is substantially zero or not. The authenticity can be therefore easily and accurately determined from the pattern (figures and patterns).

[0037] Figures 17a and 17b show a possible actual structure of the identification device 61. Figures 18a and 18b show another possible actual structure of the identification device 61. The identification device 61 shown in Figures 17a and 17b includes the identification unit 61a and identification unit 61b which are arranged parallel to each other so as to identify two different points of an identification medium having a certain width, independently from each other. The identification device 61 shown in Figures 18a and 18b includes the identification unit 61a and identification unit 61b which are arranged in a mutually crossing relationship so as to impinge light upon a same point and simultaneously identify a same point of the identification medium. The latter case allows the size of the identification object to be minimized, and the identification reliability to be improved.

[0038] The identification media described above may be formed on various cards, gift certificates and photographs of IDs and passports, and may also be formed into paper in the form of tape such as thread hologram.

[0039] Although the present invention has been described in terms of preferred embodiments thereof, it is obvious to a person skilled in the art that various alterations and modifications are possible without departing from the scope of the present invention which is set forth in the appended claims.

Claims

1. An identification medium for identifying an authenticity of an object either visually or optically by using an identification device, **characterized by that:**

the identification medium comprises high polymer cholesteric liquid crystal which is patterned and/or a graphic representation layer such as a figure and letter which underlies or overlies high polymer cholesteric liquid crystal.

2. An identification medium according to claim 1, wherein the identification medium comprises high polymer cholesteric liquid crystal which is patterned by etching.

3. An identification medium according to claim 1,

wherein the identification medium comprises a printed layer underlying the high polymer cholesteric liquid crystal

4. An identification medium according to claim 1, wherein the identification medium comprises high polymer cholesteric liquid crystal which is thermally transferred according to a prescribed pattern.

5. An identification medium according to claim 1, wherein the identification medium comprises high polymer cholesteric liquid crystal which is partly modified by laser according to a prescribed pattern.

6. A method for making an identification medium for identifying an authenticity of an object either visually or optically by using an identification device, **characterized by the steps of:**

applying high polymer cholesteric liquid crystal onto the object, onto a sticker adapted to be affixed to the object or onto a base for hot stamping onto the object; and
patterning the high polymer cholesteric liquid crystal, and/or forming a graphic representation layer such as a figure and letter under or over the high polymer cholesteric liquid crystal.

7. A method for making an identification medium according to claim 6, wherein the high polymer cholesteric liquid crystal is patterned by etching.

8. A method for making an identification medium according to claim 6, wherein an ink layer underlying the high polymer cholesteric liquid crystal is formed by printing.

9. A method for making an identification medium according to claim 6, wherein the high polymer cholesteric liquid crystal is thermally transferred onto the object, onto a sticker adapted to be affixed to the object or onto a base for hot stamping onto the object according to a prescribed pattern.

10. A method for making an identification medium according to claim 6, wherein the high polymer cholesteric liquid crystal is partly modified by laser according to a prescribed pattern.

Fig. 1

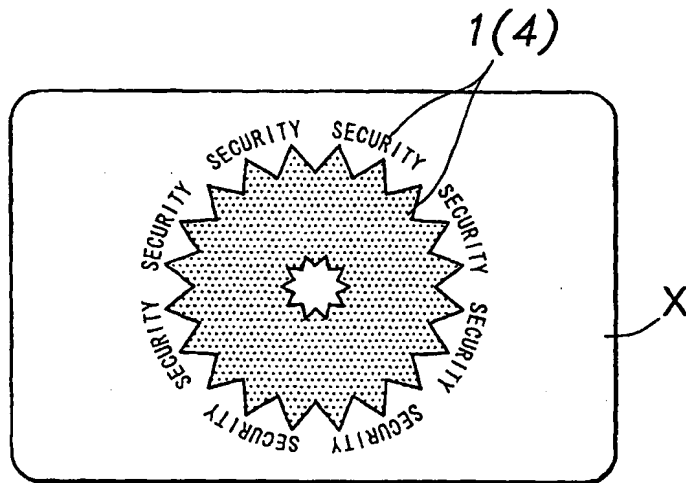


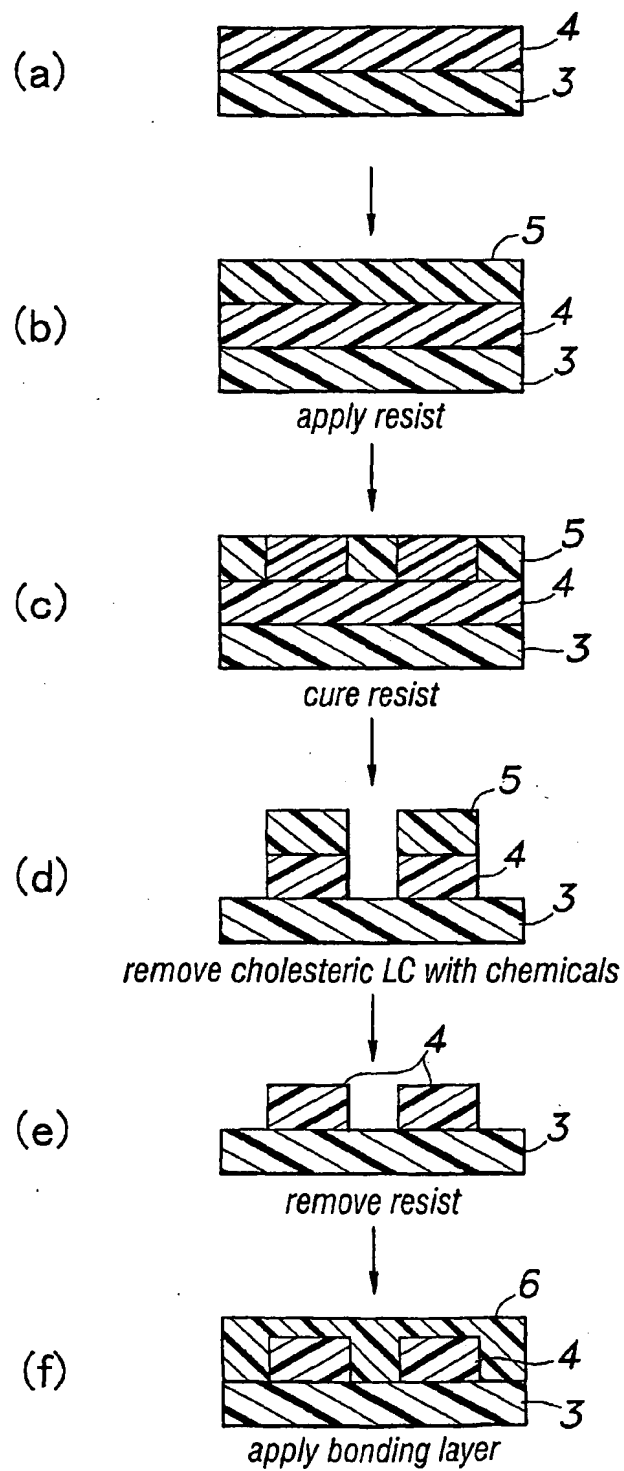
Fig. 2

Fig. 3

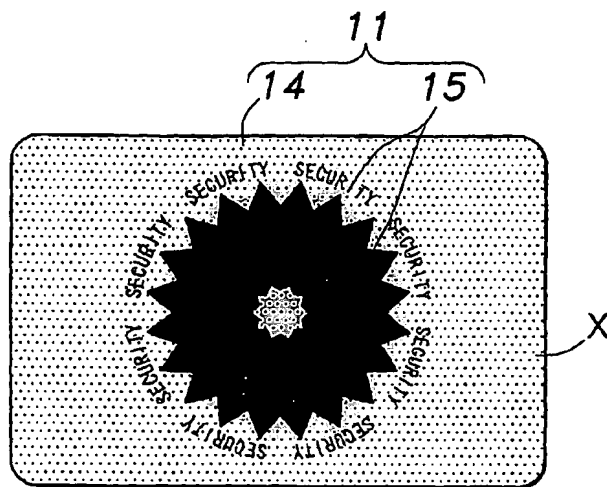


Fig. 4

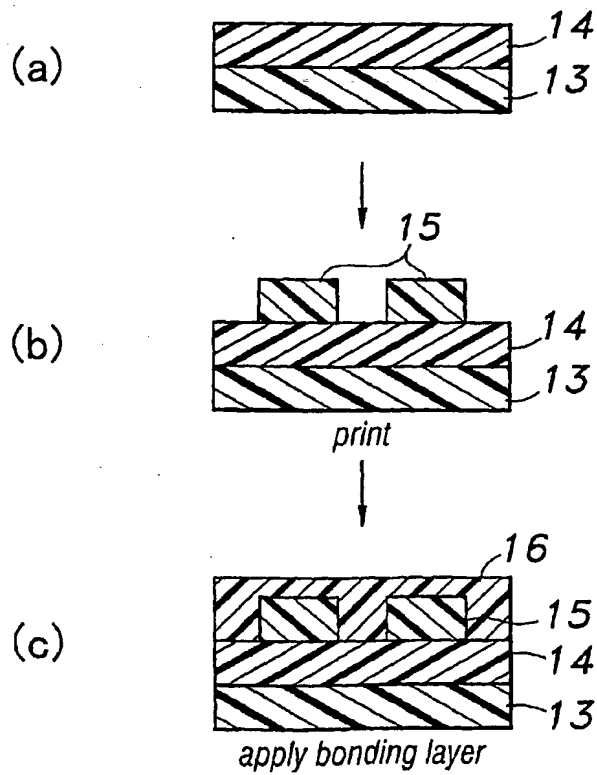


Fig. 5

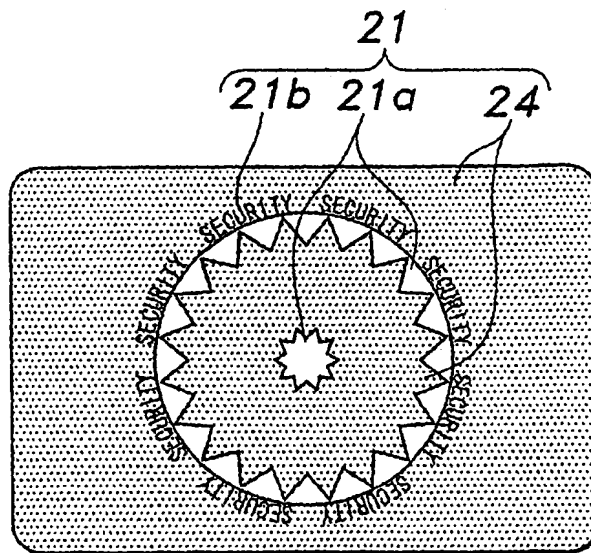


Fig. 6

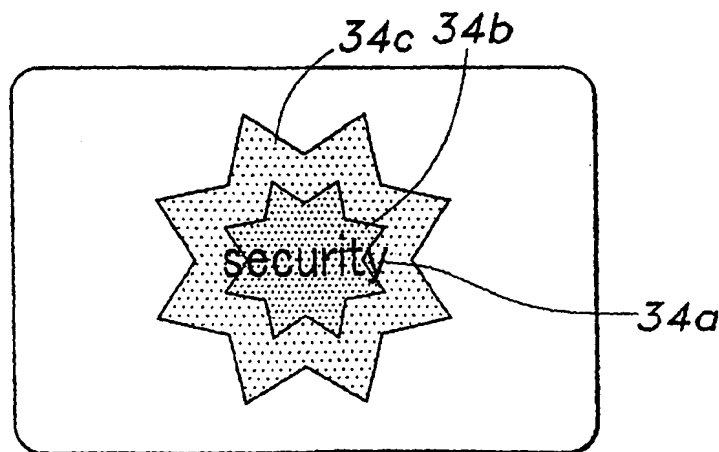


Fig. 7a

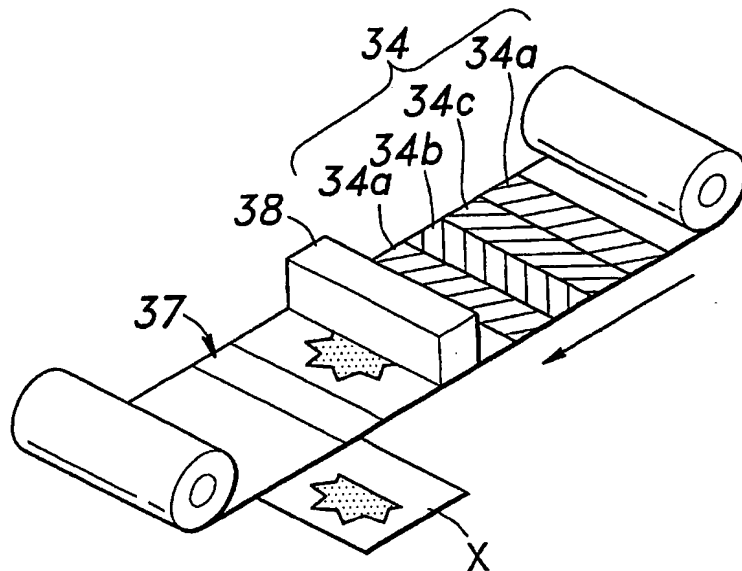


Fig. 7b

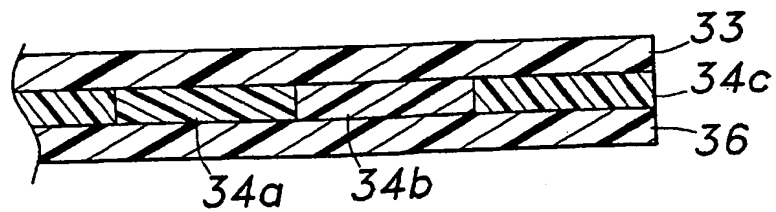


Fig. 8

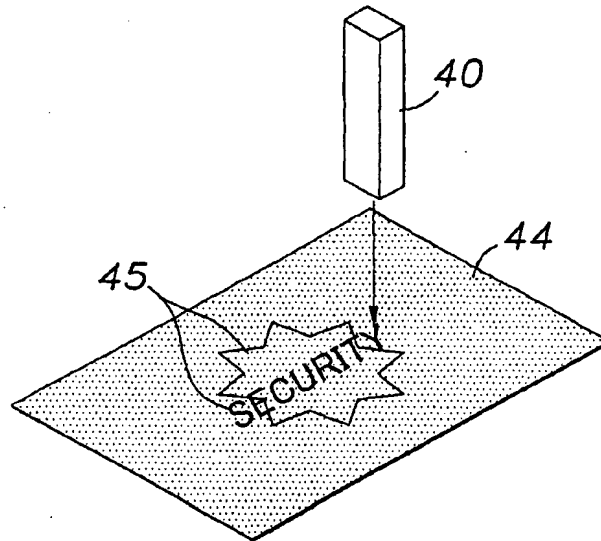


Fig. 9

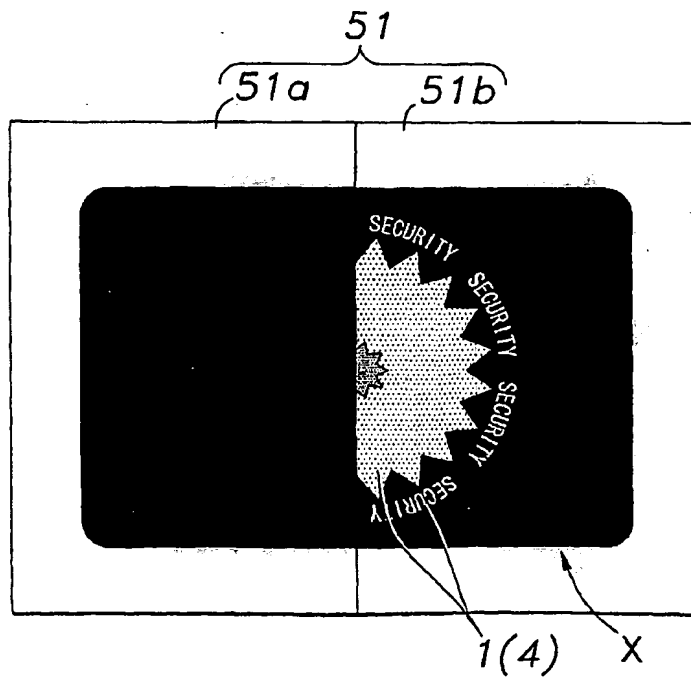


Fig. 10

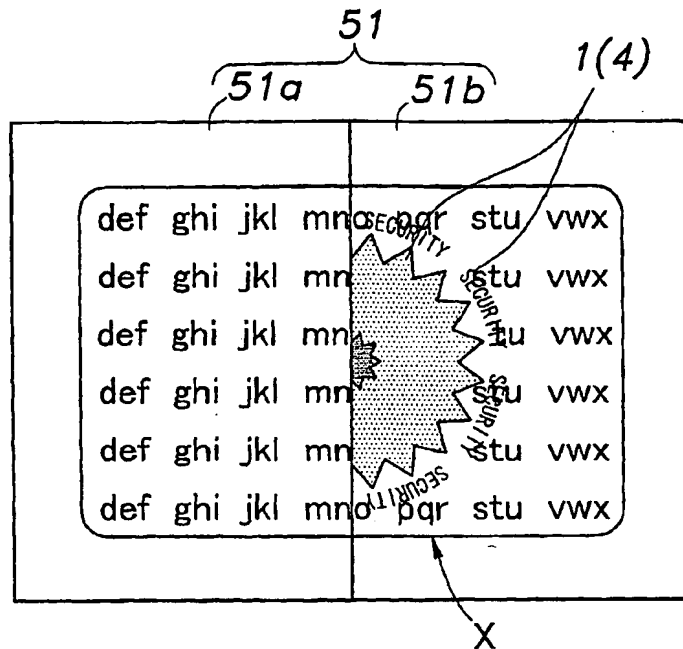


Fig. 11

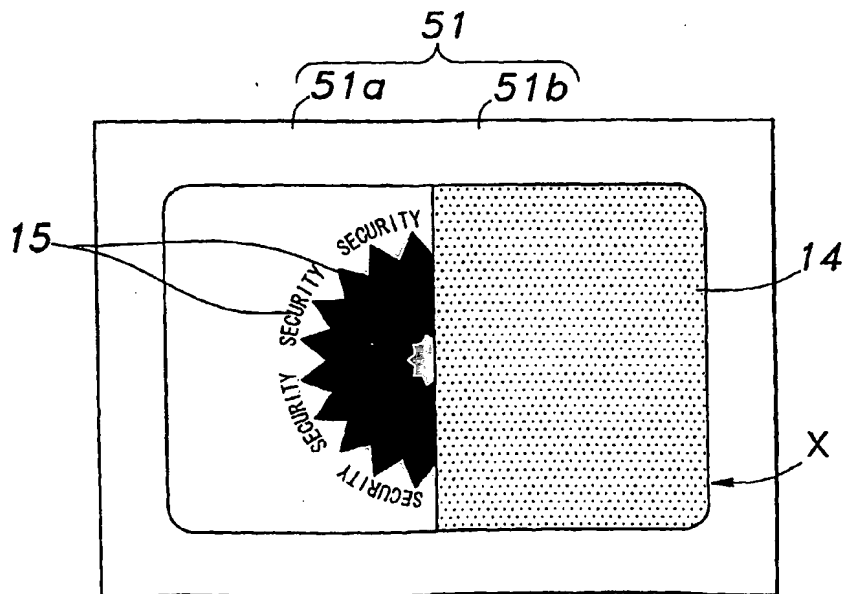


Fig. 12

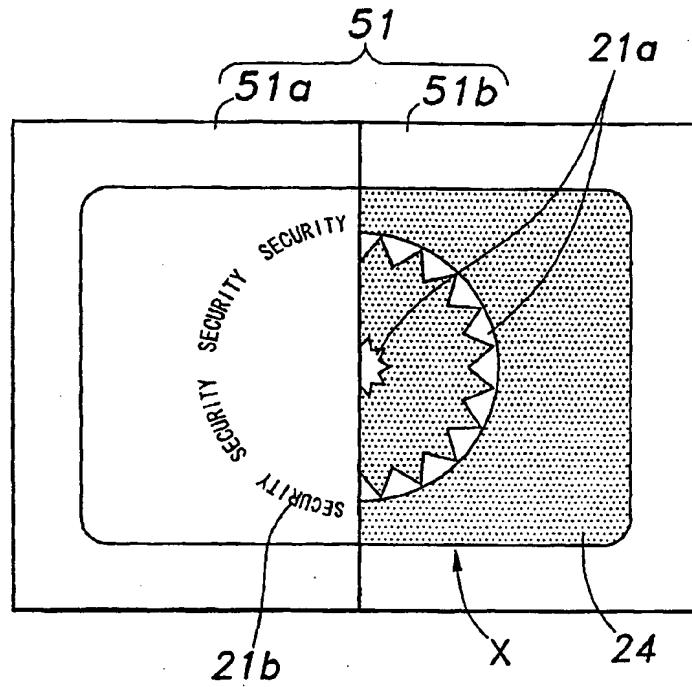


Fig. 13

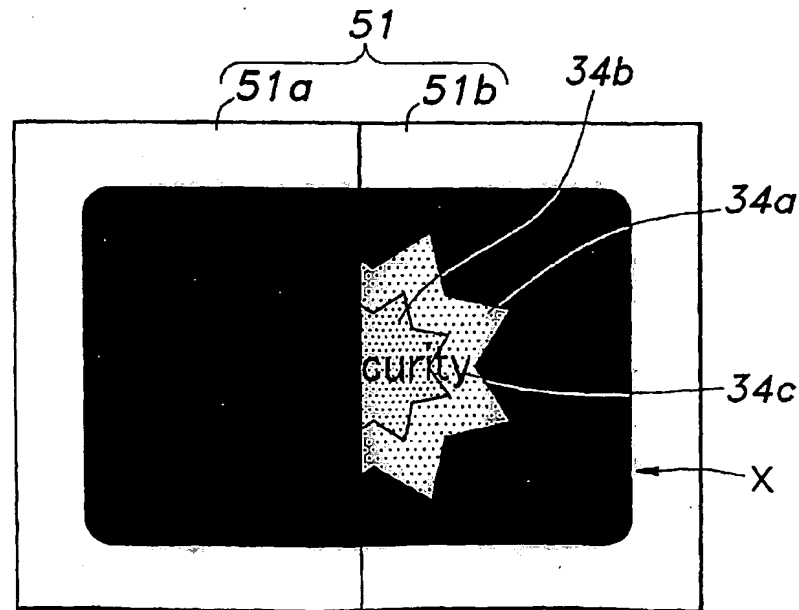


Fig. 14

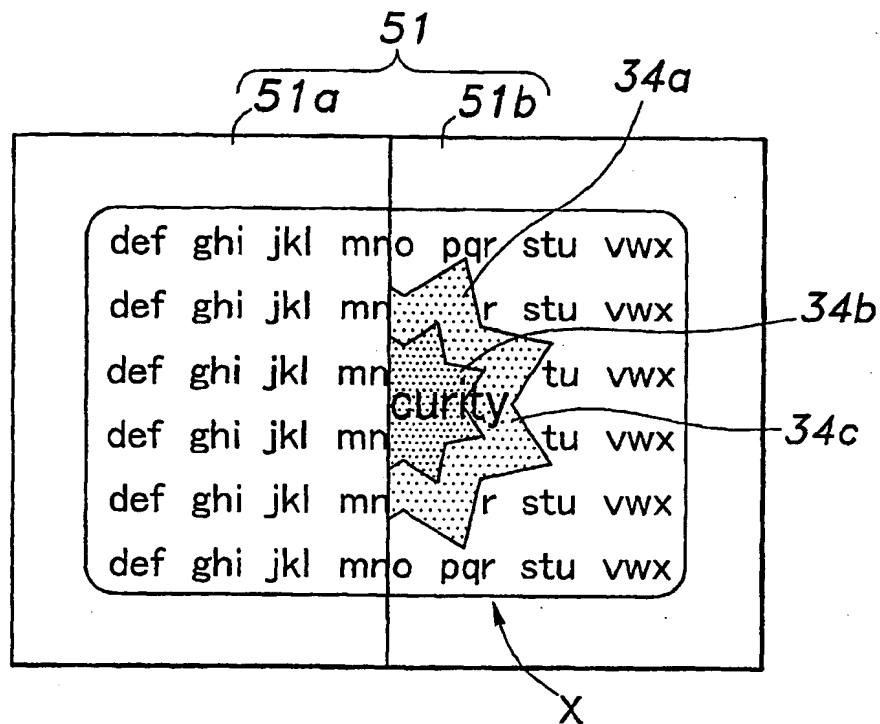


Fig. 15

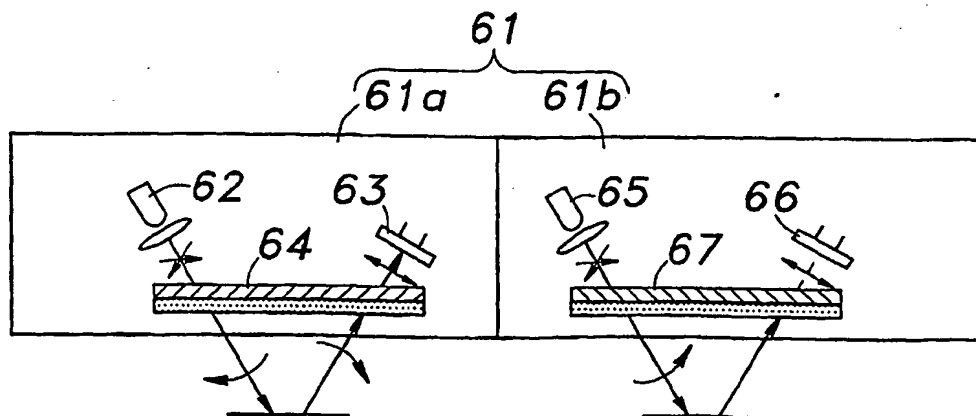
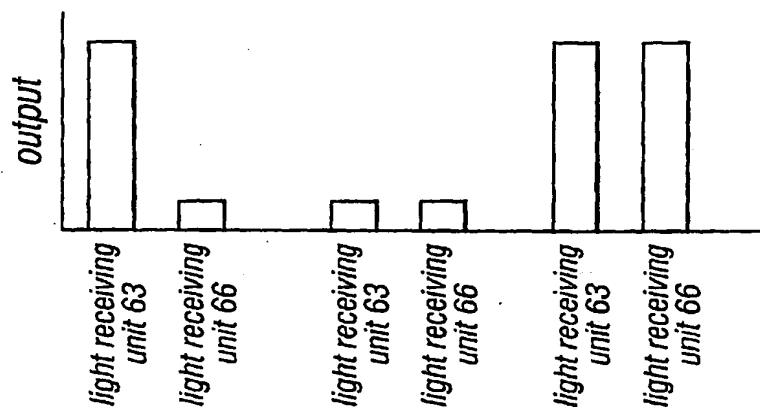


Fig. 16



LC

metal vapor
deposition layer

metal layer + half-wave
phase film

Fig. 17a

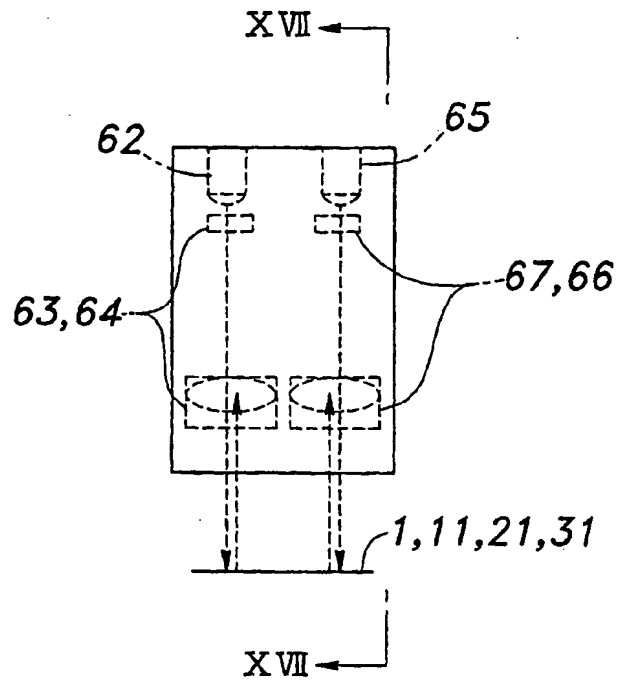


Fig. 17b

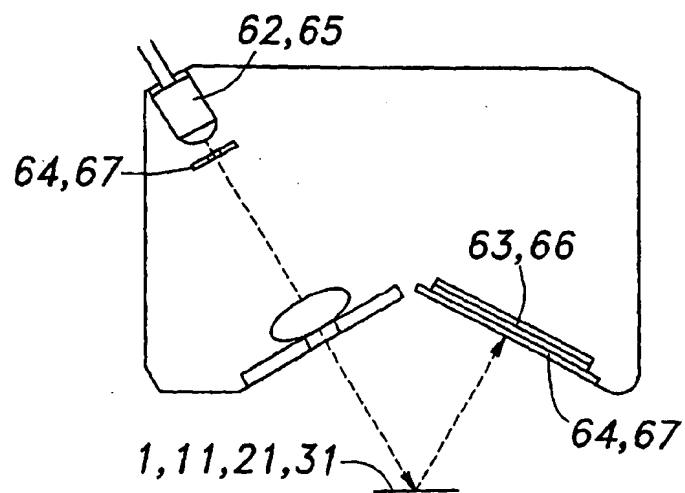
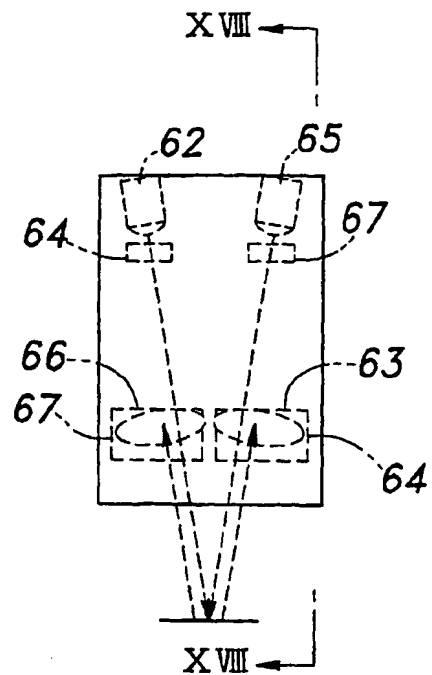
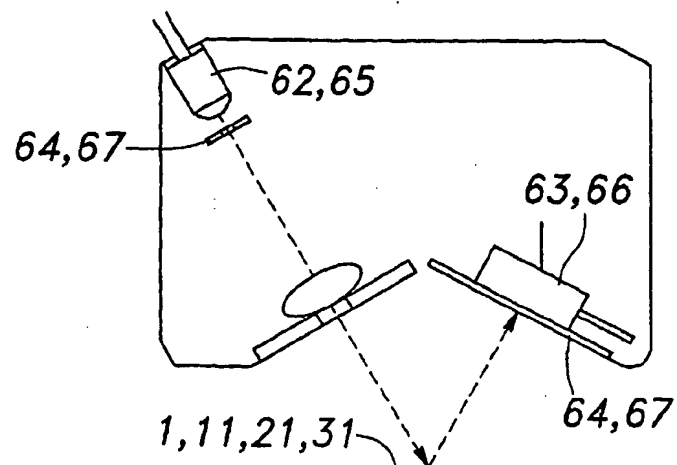


Fig. 18a*Fig. 18b*

INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP01/09157

A. CLASSIFICATION OF SUBJECT MATTER		
Int.Cl ⁷ G02B5/30, G09F19/12, B42D15/10 // G07D7/12, B44F1/12		
According to International Patent Classification (IPC) or to both national classification and IPC		
B. FIELDS SEARCHED		
Minimum documentation searched (classification system followed by classification symbols)		
Int.Cl ⁷ G02B5/30, G07D7/12, B41M1/00-5/40, B32B7/02, B44F1/00-11/16, B41C1/00-7/00, G09F3/02, G09F9/12, B42D15/10		
Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched		
Jitsuyo Shinan Koho 1926-1996 Toroku Jitsuyo Shinan Koho 1994-2002 Kokai Jitsuyo Shinan Koho 1971-2002 Jitsuyo Shinan Toroku Koho 1996-2002		
Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)		
C. DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	JP 63-51193 A (Nippon Oil Company, Ltd.),	1
Y	04 March, 1988 (04.03.88),	2-4, 6-9
A	Full text; all drawings (Family: none)	5, 10
X	JP 11-277957 A (NHK Spring Co., Ltd.),	1, 4, 6, 9
Y	12 October, 1999 (12.10.99),	2-3, 7, 8
A	Full text; all drawings (Family: none)	5, 10
X	EP 435029 A2 (GAO Gesellschaft für Automation und Organisation mbH),	1-4, 6-9
A	03 July, 1991 (03.07.91). Full text; all drawings & DE 3942663 A & CA 2032587 A & DE 59009504 G & ES 2075871 T3 & CA 2032587 C	5, 10
<input checked="" type="checkbox"/> Further documents are listed in the continuation of Box C. <input type="checkbox"/> See patent family annex.		
* Special categories of cited documents: "A" document defining the general state of the art which is not considered to be of particular relevance "E" earlier document but published on or after the international filing date "L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified) "O" document referring to an oral disclosure, use, exhibition or other means "P" document published prior to the international filing date but later than the priority date claimed "T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention "X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone "Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art "&" document member of the same patent family		
Date of the actual completion of the international search 07 January, 2002 (07.01.02)		Date of mailing of the international search report 22 January, 2002 (22.01.02)
Name and mailing address of the ISA/ Japanese Patent Office		Authorized officer
Facsimile No.		Telephone No.

INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP01/09157

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X Y A	JP 11-157200 A (Consortium Elektrochem. Ind., GmbH), 15 June, 1999 (15.06.99), Full text; all drawings & EP 899120 A1 & DE 19737618 A1 & CA 2244919 A & CA 2245127 A & KR 99023990 A & TW 385293 A & DE 59800817 G & ES 2159909 T3	1,6 2-4,7-9 5,10
X Y A	JP 11-157199 A (Consortium Elektrochem. Ind., GmbH), 15 June, 1999 (15.06.99), Full text; all drawings & EP 899119 A1 & DE 19737612 A1 & KR 99023881 A	1,6 2-4,7-9 5,10
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Y	JP 2001-232978 A (Toppan Printing Co., Ltd.), 28 August, 2001 (28.08.00), Full text; all drawings (Family: none)	5-10
Y	JP 2001-242748 A (Dainippon Printing Co., Ltd.), 08 September, 2001 (08.09.01), Full text; all drawings (Family: none)	5,10
PX PY PA	JP 2001-56484 A (Merck Patent GmbH), 27 February, 2001 (27.02.01), Full text; all drawings & KR 2001049693 A	1 2,4,6,7,9 5,10
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PX PY PA	JP 2000-255200 A (Dainippon Printing Co., Ltd.), 19 September, 2000 (19.09.00), Full text; all drawings (Family: none)	1,3,6 2,4,7-9 5,10
PX PY PA	JP 2001-105800 A (Toppan Printing Co., Ltd.), 17 April, 2001 (17.04.01), Full text; all drawings (Family: none)	1,3,6 2,4,7-9 5,10
X Y A	JP 2000-25373 A (Dainippon Printing Co., Ltd.), 25 January, 2000 (25.01.00), Full text; all drawings (Family: none)	1,6 2-4,7,9 5,10

INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP01/09157

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
PX	JP 2000-318399 A (Toppan Printing Co., Ltd.),	1, 6
PY	21 November, 2000 (21.11.00),	2-4, 7, 9
PA	Full text; all drawings (Family: none)	5, 10
PX	EP 1081728 A2 (Polymatech Co., Ltd.),	1, 4, 6, 9
PY	07 March, 2001 (07.03.01),	2, 3, 7, 8
PA	Full text; all drawings & JP 2001-63299 A Full text; all drawings	5, 10